



National Transportation Safety Board

Washington, D.C. 20594

Highway Accident Brief

Accident Number: HWY14FH013

Accident Type: Motorcoach run-off-road and overturn

Location: State Route 1 ramp to US Route 13 north, Red Lion, New Castle County, Delaware

Date and Time: September 21, 2014, 4:15 p.m.

Vehicle: 1996 Setra S215 HDH

Fatalities: 3

Injuries: 48

Crash Description

On Sunday, September 21, 2014, about 4:15 p.m. local time, a 1996 Setra motorcoach was traveling on State Route 1 (SR-1) in Delaware en route to New York City. The motorcoach was returning from a 2-day tour that originated in New York City, with planned sightseeing stops in New York State, New Jersey, Pennsylvania, Maryland, and Washington, DC. The driver reported being familiar with the planned route. However, while traveling northbound on Interstate 95, he encountered traffic congestion and decided to divert. He took US Route 40 (US-40, Pulaski Highway) northeast to SR-1 south and then entered the curved access ramp to US Route 13 (US-13) north (figure 1). The driver was unfamiliar with this alternate route and reported using his personal global positioning system (GPS) to navigate.

At the point where the SR-1 access ramp curves sharply to the right, the driver failed to negotiate the curve, and the motorcoach departed the left edge of the roadway. The motorcoach entered an earthen area, rotated clockwise, and overturned onto its left (driver) side and partially onto its roof, coming to rest about 25 feet off the roadway (figure 2).

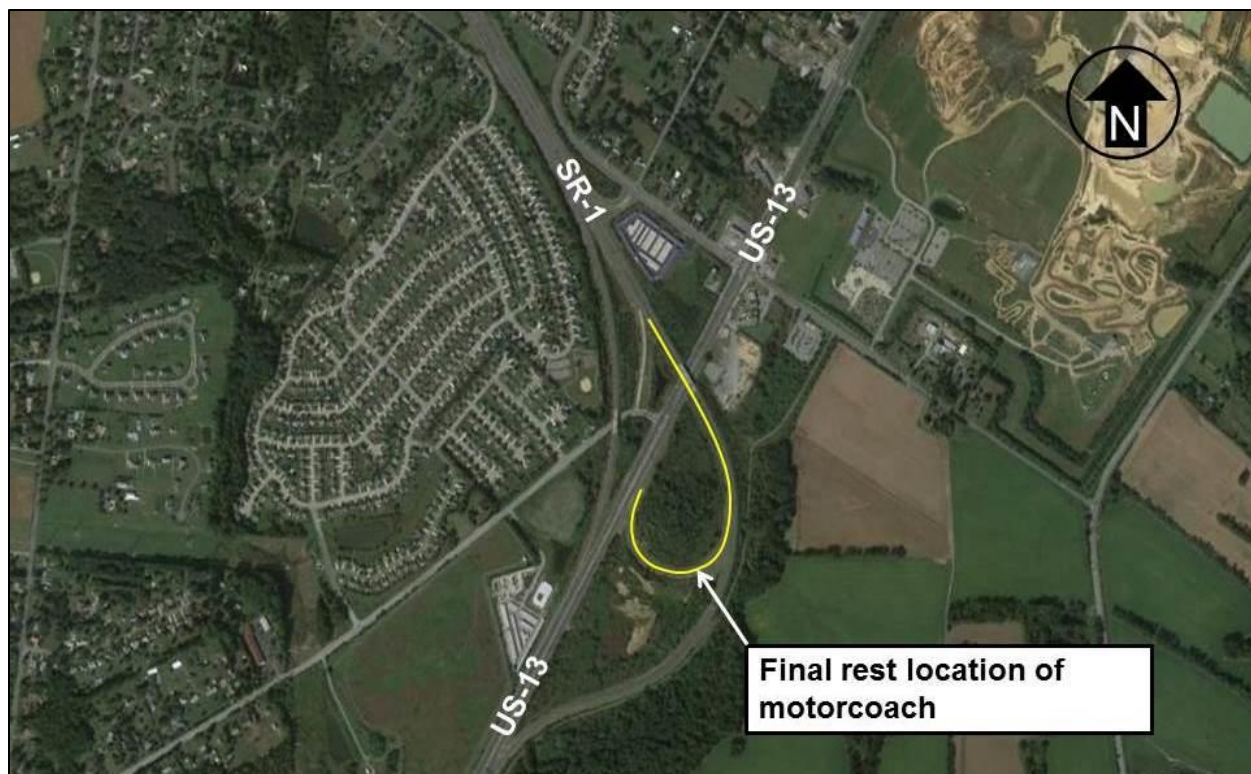


Figure 1. Curved access ramp (yellow line) from southbound SR-1 to US-13 north, showing final rest location of motorcoach. (Sources: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, Centre National d'Etudes Spatiales/Airbus DS, US Department of Agriculture, US Geological Survey, Aerials Express, Getmapping, Aerogrid, Instituto Geografico Nacional, Instituto Geografico Portugues, Swisstopo, and GISuser)

Red Lion, DE
Ramp - southbound SR-1 to northbound US-13
September 21, 2014

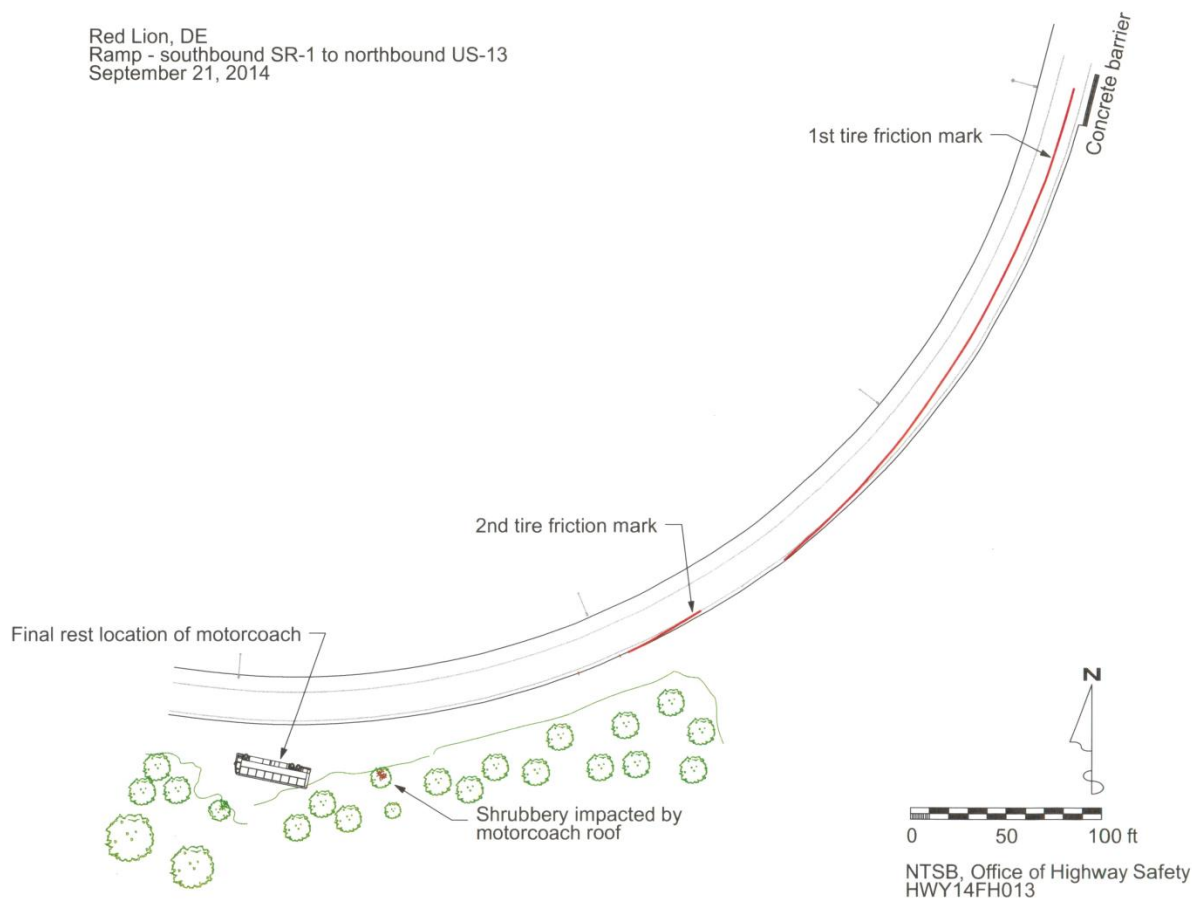


Figure 2. Crash scene diagram.

The motorcoach occupants included the 56-year-old driver and 50 passengers. The motorcoach was operated by AM USA Express. Three passengers died as a result of the crash, and the driver and 47 passengers were injured. At the time of the crash, the weather was clear, and the road conditions were dry.

The National Transportation Safety Board (NTSB) completed a field investigation of this crash, focusing on highway, vehicle, human performance, and motor carrier factors.

Highway Information

The crash occurred on the access ramp from southbound SR-1 to US-13 north near Red Lion, Delaware. The crash site is located about 7 miles southeast of Newark, Delaware. At the entrance to the access ramp, a crest vertical curve limits the visibility of the ramp ahead (figure 3, left).¹ The 1,600-foot vertical curve provides a transition between a 2 percent upgrade slope and a 3 percent downgrade slope. Beyond this point, the ramp is a horizontal curve with varying radii as it turns to the right in the direction of travel.² The radii transition from 800 to 850 feet before the end of the concrete barrier and toward the northern end of the ramp. Beyond the barrier, the ramp transitions to a 425-foot radius (figure 3, right).



Figure 3. At left, crest vertical curve at entrance to access ramp to US-13 north. At right, access ramp and relative locations of key roadway elements (adapted from figure 1).

At the time of the crash, no traffic signs were in place to warn motorists of the change in roadway curvature, or to reduce vehicle speed from 55 mph on the curved access ramp from southbound SR-1 to US-13 north.

The access ramp consists of a single 14-foot-wide travel lane with a 2-foot-wide shoulder to the left and an 8-foot-wide shoulder to the right (figure 4, left). An earthen negative slope borders the left and right shoulders. Super-elevation values along the access ramp range from 4.6 to 5.5 percent.³ Values for the pavement edge drop-off along the access ramp ranged from 0.8 to 6.0 inches (figure 4, right).⁴ At the point where the motorcoach departed the roadway, the pavement edge drop-off was about 2.5 inches. This drop-off as observed along the ramp was not

¹ A crest vertical curve is a parabolic curve or hill that provides a smooth transition from one roadway grade to another.

² A horizontal curve provides a gradual change in the direction of a roadway.

³ Super-elevation is the rotation of the roadway on the approach to and through a horizontal curve. It is intended to assist a driver by counteracting the lateral acceleration produced by tracking the curve. Measurements were taken at 25-foot intervals along the access ramp.

⁴ Pavement edge drop-off is the vertical distance between the paved edge of the roadway and the unpaved roadside surface. Depending on its magnitude, a pavement edge drop-off could affect vehicle handling and stability.

a factor in the crash, but was identified as an issue to be addressed by the Delaware Department of Transportation (DelDOT) because of potential hazards to “errant vehicles.”⁵



Figure 4. At left, view of 425-foot-radius curve on SR-1 ramp, turning to right in direction of travel, and showing final rest location of motorcoach. At right, view of most prominent edge-of-pavement drop-off along access ramp.

The average daily traffic on the access ramp is 2,582 vehicles, with heavy vehicles accounting for about 13 percent of this total. DelDOT reported a total of 19 crashes at this location between 2005 and 2013, none of which were fatal. Of these crashes, eight were associated with motorists “driving too fast for conditions,” and one was associated with a motorist “exceeding [the] authorized speed limit.” According to DelDOT, the 85th percentile speed was 49 mph at the end of the concrete barrier and 42 mph beyond the final rest location of the motorcoach.⁶

Vehicle Information

The 1996 Setra model S215 HDH motorcoach sustained extensive damage to the left side, rear, roof, and related support structures (figure 5, left). Some passenger seatbacks on the left side of the motorcoach became exposed through the window openings due to the lateral displacement of the roof (figure 5, right).

⁵ A pavement edge drop-off of 2 inches or more is considered to be a hazard to “errant vehicles.” See DelDOT Division of Transportation Solutions, “Design Guidance Memorandum: Safety Edge,” January 24, 2011.

⁶ The 85th percentile speed refers to the speed at or below which 85 percent of vehicles are traveling. The study was conducted on October 1–2, 2014.

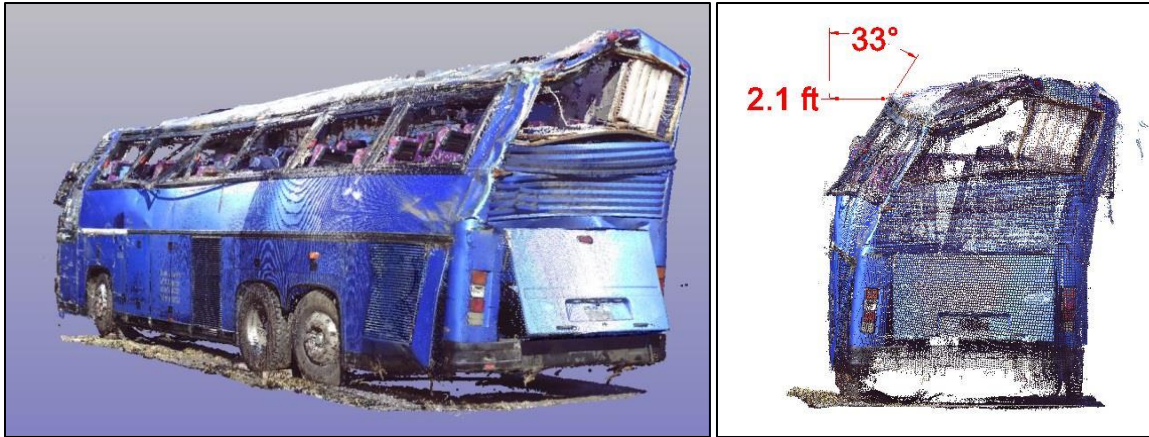


Figure 5. At left, three-dimensional scan of motorcoach showing damage to left side, rear, and roof. At right, three-dimensional scan of rear of motorcoach showing lateral displacement of roof.

The motorcoach was equipped with an electronic vehicle tracking system that recorded time, location, travel time, and speed.⁷ According to data from the on-board system, the motorcoach entered the access ramp at a speed of 61 mph and the curve area at a speed of 55 mph.⁸ A portable GPS found in the vehicle recorded the motorcoach traveling at a speed of 52–56 mph when it left the roadway.⁹ The orientation of the motorcoach at ground impact suggested a continued rightward steering effort by the driver.

The Delaware State Police Motor Carrier Safety Assistance Program (MCSAP) level 1 postcrash inspection identified several violations, including “driver cannot read or speak the English language,” “driver failed to retain previous 7 days records of duty status (logbooks),” “driver unable to understand highway traffic signs/signals,” “brake out of adjustment,” “automatic airbrake adjustment system that failed to compensate for wear, oil, and grease leaks,” and “ruptured air suspension bag.”^{10,11} None of these violations were causal or contributing factors in this crash; however, the first two violations led to the driver being placed out of service.

The NTSB inspection of the motorcoach brake system revealed that it was in compliance with the *Federal Motor Carrier Safety Regulations (FMCSR)* at 49 *Code of Federal Regulations (CFR)* 393.52.

⁷ The on-board system was the Silent Passenger by Vehicle Tracking Solutions.

⁸ The vehicle’s last recorded speed was 55 mph at 4:15 p.m. on SR-1 north, which was about the time that the motorcoach was entering the ramp to US-13 based on a change in direction from south to north.

⁹ The Garmin Nuvi 200 portable GPS device records date, time, latitude, longitude, and altitude. Ground speed and track were derived from the recorded data.

¹⁰ A level 1 postcrash inspection consists of a complete check of the driver and an inspection of the vehicle undercarriage brakes

¹¹ The first two items were out-of-service violations. The ruptured air suspension bag was attributed to the crash.

Human Performance

Driver Licensing and Training

The driver of the motorcoach held a New York class B commercial driver's license (CDL) with passenger endorsement and no restrictions.¹² According to the National Driver Registry, the driver had been involved in a crash resulting in personal injury in August 2007; and he had been issued four traffic violations between 2003 and 2011 (including a "truck route violation").¹³

The driver started working for AM USA Express in June 2010. According to the driver, he did not complete a formal training program when he began working for this carrier. No training records were found in his employment records.

Medical Fitness

The driver's most recent medical examination for commercial driver fitness determination, per 49 *CFR* 391.41, was conducted on April 8, 2014. He reported coronary artery disease and diabetes mellitus. According to the driver's physician, he met medical standards but required periodic monitoring and was issued a 6-month medical certificate, with an expiration date of October 17, 2014.

Pre-crash Activities

According to records from the driver's cell phone provider, he routinely made calls, received calls, and accessed voicemail when the vehicle tracking system indicated that the vehicle was in motion. However, the cell phone records indicated that the driver was not using his phone at the time of the crash. In 2011, the NTSB called for a ban on nonemergency use of portable electronic devices while driving.¹⁴ Unfortunately, however, we continue to see cell phone use among commercial motor vehicle operators.

The driver reported that, at the time of the crash, he was feeling ill and "blacked out." He indicated that he was taking a prescription medication (amlodipine) daily but that he did not take it on the day of the crash because he had no time to eat.¹⁵ The driver tested negative for alcohol, amphetamines, opiates, marijuana, cocaine, phencyclidine, barbiturates, antidepressants, and antihistamines.¹⁶ Amlodipine was detected in his blood and urine. Although the driver made several statements to multiple healthcare providers indicating that he had become incapacitated

¹² A passenger endorsement allows the operation of any vehicle designated to transport 16 or more passengers, including the driver. A New York class B CDL allows the operation of (1) any single vehicle with a gross vehicle weight rating of 26,001 or more pounds; and (2) all lesser vehicles, except motorcycles, with proper endorsements. The accident driver's CDL license was issued on August 20, 2008, with an expiration date of March 2021.

¹³ The driver's traffic violations involved obstructing an intersection, disobeying a traffic device, incurring a truck route violation, and operating with an insufficient turn signal.

¹⁴ See *Multivehicle Collision, Interstate 44 Eastbound, Gray Summit, Missouri, August 5, 2010*, NTSB/HAR-11/03 (Washington, DC: NTSB, 2011).

¹⁵ Amlodipine is a calcium channel blocker used to treat high blood pressure.

¹⁶ A blood sample was obtained from the driver on September 21, 2014, at 6:50 p.m., about 2.5 hours postcrash.

as a result of a cardiac-related event, a series of postcrash medical evaluations identified no obvious signs of incapacitation.¹⁷ In addition, evidence at the crash site suggested that the driver continued steering toward the right after the motorcoach left the roadway, which would indicate that he was not incapacitated in the moments before the roadway departure.

When interviewed, the driver did not provide a record-of-duty status (logbook) or information about his sleep routine, as required by 49 *CFR* 395.8. Hours of service were examined using information from the carrier dispatch log and vehicle tracking systems.¹⁸ The driver's opportunities for sleep were estimated using records from his cell phone provider and the vehicle tracking system. With these data, NTSB investigators estimated that, before working on September 20, 2014, the driver had 7.5 hours available to rest. On September 20, the first day of the trip, he began driving at 7:00 a.m. Overall, he drove 14.75 hours and was on duty (but not driving) for an additional 2.75 hours, for a total of 17.5 hours on duty—which exceeds the regulatory 10-hour maximum driving and 15-hour maximum on-duty times, respectively, as prescribed in 49 *CFR* 395.5. The driver was then off duty for 6.5 hours and had an opportunity to rest of about 6 hours. He went back on duty at 7:00 a.m. on Sunday, September 21. Because the driver did not obtain the required 8 hours off duty, he was in violation of the 10-hour driving rule and the 15-hour on-duty rule.

On previous occasions, the driver failed to provide a record-of-duty status or exceeded the hours-of-service (HOS) limits. According to data from the Federal Motor Carrier Safety Administration (FMCSA) Motor Carrier Management Information System, the driver was found to be in violation for failing to have a record-of-duty status during an inspection in Pennsylvania on September 15, 2012. Following a roadside inspection in New York on July 23, 2014, the driver was found to be in violation of both the 10-hour driving rule and the 15-hour on-duty rule and was placed out of service in accordance with 49 *CFR* 395.13.

Although it is clear that the driver exceeded the HOS limits on the day before the crash, it appears that he had up to 7.5 hours available to rest and sleep two nights before the crash and up to 6 hours available to rest and sleep on the night before the crash. However, because no evidence was available to document the actual periods that the driver may have slept, no conclusion could be made about the potential role of driver fatigue in this crash.

Motor Carrier Information

The motor carrier AM USA Express Inc. is based in New York City. The carrier transported passengers in interstate and intrastate commerce and was operating in New York, New Jersey, Pennsylvania, Delaware, Maryland, and Washington, DC. At the time of the crash, the carrier operated six buses with seven drivers.

¹⁷ On October 3, 2014, the driver underwent a cardiac catheterization. The test found no abnormalities. Two weeks later, on October 17, the driver underwent a comprehensive electrophysiology study with induction, which is a medical procedure to test the heart to determine if an arrhythmia can be induced. No abnormality was identified, and no arrhythmia was induced.

¹⁸ These data sources included the vehicle tracking system for the motorcoach he operated each day, the EZ Pass transponder, and the Maryland Coordination and Analysis Center.

Roadside Inspections

The FMCSA Safety Measurement System is a program for assessing the relative performance of a carrier regarding unsafe driving, HOS compliance, driver fitness for duty, controlled substances/alcohol, vehicle maintenance, and hazardous materials compliance—the behavior analysis and safety improvement categories. In addition, the Safety Measurement System monitors crash involvement, including frequency and severity. According to these data, AM USA Express had undergone a total of 30 roadside inspections in a 24-month period, ending August 22, 2014. Ten of these inspections resulted in violations. In particular, the inspections found that the carrier had exceeded the FMCSA threshold for HOS compliance, including violations of the 10-hour driving rule and 15-hour on-duty rule, and had issues with driver records-of-duty status. The carrier also had one reported crash during that period.

Compliance Reviews

The FMCSA may evaluate a carrier's compliance with the *FMCSRs* by conducting a compliance review. The safety rating methodology, as outlined in 49 *CFR* 385.5, evaluates patterns of critical or acute violations. Critical violations relate to management or operational controls. Acute violations are those for which noncompliance is so severe that immediate corrective action is required by the motor carrier.¹⁹ Several factors are rated. The numbers of unsatisfactory and conditional ratings for the factors are then entered into a table, which establishes the motor carrier's overall safety rating of satisfactory, conditional, or unsatisfactory, as shown in table 1.²⁰ A compliance review that is specific to one section—or a focused examination—results in a nonrated designation.

Table 1. FMCSA motor carrier safety ratings.

Factor Ratings		Overall Safety Rating
Unsatisfactory	Conditional	
0	2 or fewer	Satisfactory
0	More than 2	Conditional
1	2 or fewer	Conditional
1	More than 2	Unsatisfactory
2 or more	More than 2	Unsatisfactory

¹⁹ Appendix B of 49 *CFR* 385 lists acute and critical violations.

²⁰ A satisfactory rating indicates that a motor carrier has in place and functioning adequate safety management controls to meet the safety fitness standard prescribed in 49 *CFR* 385.5. A conditional rating indicates that a motor carrier does not have adequate safety management controls in place to ensure compliance with the safety fitness standard, which *could result* in the occurrences listed in section 385.5 (a) through (k). An unsatisfactory rating indicates that a motor carrier does not have adequate safety management controls in place to ensure compliance with the safety fitness standard, which *has resulted* in the occurrences listed in section 385.5 (a) through (k).

On May 5, 2010, the FMCSA conducted a compliance review of AM USA Express. The review found three violations, none of which were critical or acute. No safety rating was assigned to the carrier (a nonrated designation). Postcrash, on October 14, 2014, the FMCSA conducted another compliance review of AM USA Express. The carrier had 13 violations, two of which were critical and one of which was acute. The critical violations involved making a false record-of-duty status and operating a motor vehicle not in accordance with the jurisdiction's laws, ordinances, and regulations, per 49 *CFR* 395 and 392, respectively. The acute violation involved failing to implement a random controlled substance and/or alcohol testing program, as specified in 49 *CFR* 382. Other deficiencies noted involved the qualifications of drivers and vehicle inspection, repair, and maintenance. On the basis of these results, the carrier received an unsatisfactory rating because of the lack of adequate safety management controls to ensure compliance with the FMCSA safety fitness standard.

After receiving notification of the rating, AM USA Express failed to submit a corrective action plan to the FMCSA within 45 days describing how it would remedy safety deficiencies, as specified in 49 *CFR* 385.319. As a result, the FMCSA issued an out-of-service order for the carrier on December 2, 2014.²¹

Postcrash Actions

DelDOT Roadway Improvements

The 2009 *Manual on Uniform Traffic Control Devices* (MUTCD) provides standards for the use of signs in advance of horizontal curves on freeways, expressways, and roadways with a traffic volume of more than 1,000 vehicles per day.²² The standards were not in effect when the access ramp from southbound SR-1 to US-13 north was built, in the early 1990s. The 2012 Delaware MUTCD sets December 31, 2019, as the target date for compliance with the standards for applicable facilities within the state (which is consistent with the target compliance dates established by the Federal Highway Administration).

On October 9–10, 2014, DelDOT installed new traffic signs on the access ramp that meet the requirements of the 2009 MUTCD. These signs include the following:

- A 35-mph combination horizontal alignment/advisory exit sign (W13-6) located before the crest vertical curve (figure 6, left).
- A horizontal alignment sign (W1-15) with a 35-mph advisory speed plaque sign (W13-1P) located beyond the crest vertical curve.
- A 35-mph combination horizontal alignment/ramp speed sign (W13-7) located near the 800-foot radius (figure 6, right).
- A truck rollover warning sign (W1-13) with a 35-mph advisory speed plaque sign (W13-1P) located near the 850-foot radius (figure 7, left).

²¹ This out-of-service order was still in effect as of December 2015.

²² See mutcd.fhwa.dot.gov/, page 110.

- Thirteen high post-mounted chevron signs (W1-8) spaced at 120-foot intervals along the loop ramp (figure 7, right).²³



Figure 6. At left, new 35-mph combination horizontal alignment/advisory exit sign located in advance of crest vertical curve. At right, new 35-mph combination horizontal alignment/ramp speed sign located near 800-foot radius. (Source: DelDOT)



Figure 7. At left, new truck rollover warning sign with 35-mph advisory speed plaque sign located near 850-foot radius. At right, new chevron signs spaced at 120-foot intervals along loop ramp. (Source: DelDOT)

With the assistance of DelDOT staff, NTSB investigators determined that the shoulder required regrading to eliminate the edge-of-pavement drop-off. In summer 2015, DelDOT regraded the shoulder to meet the elevation of the asphalt surface on the loop ramp.

²³ The letters and numbers in parentheses are the MUTCD-specified identifiers for each sign.

Probable Cause

The National Transportation Safety Board determines that the probable cause of the September 21, 2014, motorcoach crash near Red Lion, Delaware, was the excessive speed at which the driver negotiated the decreasing radius of the single-lane access ramp from State Route 1 to US Route 13 north, resulting in a loss of control of the motorcoach. Contributing to the crash were the decreasing radius curve and the lack of traffic signage warning of the curve.

Adopted: January 11, 2016